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ORIGINAL ARTICLE

Disordered eating in French high-level athletes: association with type of sport, doping behavior, and psychological features

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Abstract
Purpose Over the last few years, disordered eating in athletes has received increasing attention. According to several studies, athletes could be more vulnerable to disordered eating and some characteristics specific to the athletic community could be in favour of an increased risk of poor body image and disturbed eating habits in athletes. However, the literature is sparse and some methodological issues in studies have been pointed out. In this context, we aimed at determining the prevalence of disordered eating in French high-level athletes using clinical interviews of three different clinicians and identifying what are the factors associated with disordered eating in athletes.
Methods In France, all athletes registered on the French high-level list have to undergo a yearly evaluation. Data collected during the somatic assessment, the dietary consultation, and the psychological of the yearly evaluation were used. Multivariate analysis was performed for identification of factors associated with disordered eating.
Results Out of the 340 athletes included, 32.9% have been detected with a disordered eating. They were difficult to detect by clinicians, as usual criteria did not seem to be reliable for athletes. Competing in sports emphasizing leanness or low body weight was associated with disordered eating; however, gender was not.
Conclusion These results highlight the need for the development of specific screening tools for high-level athletes. Furthermore, the identification of factors associated with disordered eating could improve early detection and prevention program effectiveness.

Keywords Disordered eating · High-level athletes · Sport · Prevalence · Associated factors

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Introduction

Over the last few years, problematic weight-control behavior (chronic dieting, fasting, frequent weight fluctuation, excessive training, etc) in athletes has received increasing attention [1–3]. To assess athletes' vulnerability to disordered eating (DE), many studies have compared the prevalence of DE among athletes and non-athletes [4–11] but the prevalence and conclusions are mixed. A few years ago, Smolak et al. conducted a first meta-analysis to address whether or not female athletes were at greater risk for eating problems than female non-athletes [12]. They selected all studies assessing disordered eating in female athletes (elite or not) and a comparison group of female (non-athletes or non-elite athletes) and concluded that there were some circumstances under which sport participation by women constitutes a risk factor for eating problems (elite sports and sports emphasizing leanness). A more recent systematic review, focused on young male and female elite athletes, was not able to conclude on a higher risk of pathogenic weight-control behavior in elite athletes when compared to control groups [3]. They also concluded that leanness sports could be a risk factor for weight manipulation. For both meta-analysis and systematic review, it was underlined that methodological problems across the different studies make a final conclusion impossible (heterogeneity of athletes, lack of clear definition for disordered eating, and use of self-report measures). However, for both, leanness sports seemed to be a risk factor for the development of disordered eating in athletes. Sports emphasizing leanness or low body weight include sports with an aesthetic dimension, sports in which gravity plays an important role (heavier athletes being perceived as slower or less well-performing) and weight-class sports [10].

In addition to leanness sport, we can assume that several characteristics specific to the athletic community could be in favour of an increased risk of poor body image and disturbed eating habits in athletes. For example, in almost all sports, a body type is thought to be "ideal" both in terms of performance and aesthetics [13] and athletes aimed at fitting this ideal body type. However, this ideal body type is not always in line with the aesthetic standards of society [13, 14] and may increase body image dissatisfaction in athletes. Therefore, athletes could be under increased pressure to achieve a perfect body in the aim to improve their performance. This pressure may be exacerbated by their coaches and peers' attitudes [15]. A recent study showed that the pressure relating to a competitive sport environment promotes the emergence of dangerous and unhealthy eating behaviors [16]. The quality of the relationships with coaches and team members may be essential to DE development among athletes [17]. The athlete's personality is also a factor to be addressed. For example, perfectionism is often associated with athletes' characteristics and could be a risk factor for ED [2, 14, 18, 19].

Some disordered eating habits specific to athletes (e.g, anorexia athletica, and bigorexia) have also been described in the literature [20–22]. However, they remain difficult to detect for athletes, their family, sport professionals, and the medical community, because they are neither validated criteria nor consensus on their classification [13, 23].

Taking into account the difficulties of previous studies (bias of self-report measures for DE, lack of validated tool for DE diagnosis, and selection of particular group of athletes), we decided to assess DE using clinical interviews in French elite athletes when they come for their mandatory yearly evaluation in Medical Units of Prevention Doping. Our aims were to determine (a) how many athletes were identified with DE by three different healthcare professionals (sport physician, dietician, and psychologist); (b) whether the athletes detected with DE were the same for all healthcare professionals, and (c) if they were some factors associated with DE in athletes.

Methods

Participants

In France, the athletes registered on the French high-level list are athletes selected individually by their national sport federation to compete in national or international sporting events. Athletes registered on the French access to high-level pathway list are athletes who have already achieved sport performances that are exceptional for their age, at either a national or an international level. All these athletes have to undergo a somatic assessment, a dietary consultation, and a psychological assessment as part of their yearly evaluation. All the data from these three evaluations were collected between June 2010 and December 2012 at three main Medical Units of Prevention Doping for athletes in France. All athletes from the age of 12 years could be included in the study.

Three hundred and forty athletes were included. Thirty-seven sporting disciplines were represented and sport type (leanness sports vs. non-leanness sports) were classified according to the literature [10] (S1 table). Leanness sports were defined as sports emphasizing leanness or low body weight (aesthetic sports, weight-class sports, endurance sports, and low-weight performance sports). Non-leanness sports included sports, where leanness and/or low body weight are considered less important (power sports, 'technical' sports, and ball sports).

Measures

Since 2006, the French Ministry of Sports has decided to set up a Statutory Medical Monitoring (SMM) (articles L.3621-2 and R.3621-3 of the French code of public health) for high-level athletes. Thus, athletes registered on the French high-level list or on the French access to high-level pathway list must undergo a yearly examination which combines a somatic assessment by a sport physician, a dietary consultation by a dietician, and a psychological assessment by a psychologist. These healthcare professionals, whose expertise in the management of DE is recognized [24], are the most competent in detecting DE among athletes. Therefore, the data collected were data from the somatic assessment, the dietary consultation, and the psychological assessment of the SMM.

Somatic assessment

The variables collected were the data from the clinical examination, fatigue assessment, delayed puberty (i.e., Tanner stage below P5 for athletes over the age of 14 years), and history of menstruation for women. To eliminate the wide differences due to the athletes' ages, we controlled the "normality" of the BMI according to age and sex, using the Rolland-Cachera growth charts (Rolland-Cachera et al. 1991).

Dietary consultation

The variables collected were eating disorders family history, athlete's dietary habits using 24 h recall interview, and food frequency questionnaire (energy intake, fats and cooking method, snacking, and skipped meals) and their diet during competitions (change in diet, consumption of food supplements, and weight variations between athletic seasons).

Psychological assessment

Variables were collected using the Interview Grid for Multidimensional Assessment of Athletes (IGMAA) [25]. It is a semi-structured interview which encourages an overall medical, psychological, and social approach through exploration of important areas in the athlete's quality of life: their activities, their family and social relations, health, substance use (including doping behavior), relationship with their body and dietary habits, psychological state (depressive symptomatology, anxiety, sleep disturbance, risk of suicide, etc). It was designed for the use in both adults and adolescents. As DSM 5 [26] were not yet available, DE and other psychiatric comorbidities were assessed using DSM IV criteria [27].

Eating disorder inventory (EDI) [28]

The EDI is a 64-item self-report instrument (scored from 0 to 3 points) assessing the symptoms and psychological features of ED. It consists of eight subscales measuring: drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interceptive awareness, and maturity fears. The EDI gives a score for each of the eight dimensions. The EDI has demonstrated good reliability and validity [29] and was completed by athletes during the psychological assessment.

Procedure

The somatic, dietary and psychological assessments were the same as usual, as part of the SMM and were conducted in a successive way by three different healthcare professionals experimented in DE detection (sport physician, dietician, and psychologist). At the end of his assessment, each clinician had to indicate if he had detected a DE and the type of DE (anorexia nervosa, bulimia nervosa, binge eating disorder, eating disorders not otherwise specified EDNOS). For each athlete, the three evaluations took place close together in order to avoid evaluation bias. Clinicians did not have access either to the data collected or to the conclusions of the other clinicians.

Statistical analysis

All statistical analyses were conducted using the SAS Software v.9.3 (SAS Institute Inc., NC, USA). Descriptive analyses were expressed as number and percentage for qualitative variables and expressed as minimum, maximum, means, standard deviation, and quartiles for quantitative variables. Athletes were classified as "DE detected" if at least one of the three interviewers considered the athlete as having a DE.

Inter-observer agreement was performed using kappa statistics with a 95% confidence interval.

A univariate logistic regression and multivariate stepwise logistic regression were performed to analyze factors associated with DE. Variables candidates for the multivariate model were those associated with DE in univariate analyses with $p < 0.25$ criterion (except for variables related to only a subset of athletes and variables used by interviewers to detect DE) and subsequently selected in the model using $p < 0.05$ criterion. Quality of the final model was assessed by a Hosmer and Lemeshow test. For all analyses, a p value <0.05 was deemed to be statistically significant.

Ethics

The study procedures were carried out in accordance with the declaration of Helsinki. This study was approved by the Tours Ethics Committee. All athletes declared they were not opposed the study. Minors were able to declare their non-opposition through a legal representative.

Results

Three hundred and forty athletes were included in the study, 37.6% of them competed in leanness sport. Table 1 shows the socio-demographic and sport-related characteristics of athletes.

Disordered eating prevalence

A hundred and twelve athletes were detected by at least one of the clinicians as having a DE (32.9%). Concordance between clinicians in detection of DE was 0.19 [0.13, 0.25]. Most of the DE was EDNOS for the three clinicians (97.2% for the psychologists, 92.6% for the dieticians, and 88.0% for the sports physicians).

Associated factors and univariate comparison

Table 2 shows the univariate comparison between the two groups of athletes "DE detected" and "no DE detected". Female athletes and athletes practicing leanness sports were significantly more frequent in the "DE detected" group (for female gender: 47.3 vs. 32.5%; OR 1.87 [1.18–2.97], $p < 0.01$; for leanness sports 50.0 vs. 31.3%; OR 2.20 [1.38–3.50], $p < 0.01$). There was no significant difference in mean BMI. However, the number of athletes with the lowest BMI (lower than the tenth percentile for age and sex) was significantly higher in the "DE detected" group. Athletes in the "DE detected" group had more often an insufficient spontaneous energy intake compared to the recommended energy intake. All the variables from the relationship with body and dietary habits section of IGMAA showed a significant difference between the two groups. For each of the groups, a significant proportion of athletes attributed their weight and shape concerns to the improvement in sport performances (81.3% of athletes in the "DE detected" group and 93.8% of athletes in the "no DE detected" group). Nevertheless, weight and shape concerns to improve the physical appearance were significantly more common in the "DE detected" group (75.0 vs. 37.5%; OR 5.00 [1.50–16.70]; $p < 0.01$). Weight, shape, and eating concerns were more often incapacitating (64.8 vs. 37.1%; OR 3.12 [1.29–7.55]; $p = 0.02$) and had more often negative consequences for athletes in the "DE detected" group (80.7 vs. 61.1%; OR 2.66 [1.04–6.81]; $p = 0.04$). There were significantly more anxio-depressive states, history of violence (psychological and/or physical and/or sexual) loss of self-confidence and doping behavior (using licit or illicit substances to get over actual or perceived obstacles, and/or to improve their performances, whether physical, intellectual, or artistic) in the "DE detected" group. EDI scores for drive for thinness, body dissatisfaction, perfectionism, interpersonal distrust, and interceptive awareness were significantly higher in the "DE detected" group.

Associated factors, multivariate comparison

Table 3 shows the results of the multivariate analysis. Variables significantly associated with the "DE detected" group were doping behavior, competing in leanness sports, fatigue score higher than 6, having lost self-confidence, higher EDI drive for thinness and body dissatisfaction scores, and lower EDI ineffectiveness score. Being female, age, anxio-depressive state or history of psychological, physical, and/or sexual violence and other EDI subscales were not significantly associated with the "DE detected" group. The quality of the final model was good (Hosmer and Lemeshow test $p = 0.58$).

Discussion

In the present study, the prevalence of DE in athletes was of 32.9%. Sundgot-Borgen et al. [2] have drawn-up an inventory on the prevalence of clinical and subclinical ED in athletes: around 40% of female athletes competing in an aesthetic sport, 30% of female athletes competing in weight-class sports, 24% of male athletes competing in gravitational sports, and 18% of male athletes competing in weight-class sports. Our prevalence seemed to be higher, but the younger age of athletes (16.8 years on average) and the main criterion of the study (at least one clinician having detected a DE) may explain this prevalence.

Athletes detected by the three clinicians as having DE were not the same, but we observed that DE detected were mostly EDNOS for all clinicians. It may be assumed that DE in athletes not fit the criteria usually used for detection of eating disorders [26], and in consequence, detecting DE in high-level athletes is all the more difficult. For example, the BMI, which is an important somatic criterion in the screening of the general population, is not selective in high-level athletes. We do not observe a significant difference in mean BMI between athletes with DE and other athletes. The percentage of athletes with a BMI lower than the tenth percentile on the growth chart for age and sex was higher in the "DE detected" group, but they represented

Table 1 Socio-demographic and sport-related characteristics for all athletes ($n = 340$)

Variables	% or m (sd)
Age (years)	16.8 (3.5)
Male	62.7%
Civil status	
Single	99.1%
Main activity	
Adapted schooling	68.2%
Studies	22.7%
Employed	3.5%
Sponsored sport activity	2.1%
Unemployed	1.2%
Other	2.3%
Living conditions	
Establishment/boarding school/youth residence	50.4%
With parents/family	35.7%
Alone	6.8%
With friends	4.4%
With partner	2.4%
Non-stable living conditions	0.3%
Sports	
Age of onset (years)	8.5 (3.6)
Length of regular practice (years)	5.7 (3.5)
Length of intensive practice (years)	2.3 (3.2)
Time spent on sporting activity (h/week)	13.1 (4.7)
Sport disciplines	
Sports with an aesthetic dimension	2.6%
Weight-class sports	7.9%
Endurance and gravitational sports	27.1%
Power sports	20.3%
Technical sports	16.5%
Ball sports	25.6%
Role of sport	
Exclusive	6.2%
Main	87.9%
Secondary	5.9%
Long-term sport objectives	
National/international	97.1%

%, percentage; m, mean; sd, standard deviation

only a little part of the athletes (less than 2%). Gomes et al. had already emphasized that weight was not a reliable indicator to detect DE in athletes [30], sport performance being the priority for athletes, which is not compatible with a very low BMI. Delayed puberty, often related to eating disorders in the general population, is not a selective indicator either, since intense physical exercise promotes delayed puberty [31]. Exploration of dietary habits is also complex. What is considered as an inappropriate eating behavior (e.g, rapid weight loss, sweating, and water deprivation) by the general population could be seen by athletes as inherent to the sport discipline and could be even promoted by coaches and practiced with other team members. Finally, psychological assessment is also complex as body is a major focus for athletes regardless of DE.

Another important finding was that the reasons for weight, shape, and eating concerns were not the same between the two groups. Although for both, improvement in sport performance was a strong motivation, more often, athletes with DE also wished to improve their physical appearance and their self-confidence. This is quite interesting as motivation for weight concerns could be addressed more often by coach or clinicians to detect athletes possibly at risk for DE.

The multivariate analysis showed several factors significantly associated with DE in French high-level athletes. As in the systematic review conducted by Werner et al. [3] athletes with DE competed more often in leanness sports. Doping behavior was also frequently found in athletes with DE. To our knowledge, there are no studies assessing the relationship between DE and doping behavior in athletes except for body builders. This relationship should be investigated. Another result of our study showed that athletes with DE often lacked self-confidence but did not feel ineffective. Studies about the relationship between self-esteem and DE in athletes have also mixed results. Maybe athletes with DE report even higher self-esteem to protect themselves or maybe they find a way to increase their self-confidence in the quest for thinness and for an ideal body type [11]. Although female athletes are usually at higher risk for DE [3], we did not find a significant association in the multivariate analysis. Other variables associated with DE in the univariate analysis, did no longer relate to DE in the final regression model (perfectionism, anxio-depressive state, and history of violence). As put forward by other authors for perfectionism [14], these variables may play the role of moderators. Maybe gender is related to DE in athletes but in specific sports, or combined with specific individual characteristics (e.g, self-esteem and psychiatric comorbidities).

The choice of a clinical interview to detect DE was a strength in our study as previous studies and guidelines indicated that athletes tended to underestimate or underreport their disordered eating behaviors with self-reported questionnaires [32–34]. However, our findings need to be considered in the light of some limitations. The study design precludes conclusions regarding causal relationships between variables. Results are based on the identification of DE by clinicians and not on a diagnosis. This choice was motivated by the will to identify associated factors at early stages of disordered eating behaviors. The complementarity of the three clinicians in detecting DE in athletes was also pointed out, each one providing useful clinical factors

Table 2 Univariate comparison of athletes with and without DE detected

Variables	DE detected, $n = 112$ % or m (sd)	No DE detected, $n = 228$ % or m (sd)	OR [95% CI]	p
Socio-demographic and sport-related				
Age (years)	17.1 (3.2)	16.6 (3.6)	1.04 [0.98–1.11]	0.22
Female	47.3%	32.5%	1.87 [1.18–2.97]	<0.01
Age of onset (years)	8.7 (3.8)	8.5 (3.5)	1.02 [0.95–1.08]	0.61
Length of regular practice (years)	5.8 (3.7)	5.6 (3.4)	1.01 [0.95–1.08]	0.78
Length of intensive practice (years)	2.4 (2.2)	2.2 (3.5)	1.02 [0.95–1.09]	0.59
Time spent on sporting activity(hours/week)	13.3 (5.2)	13.0 (4.5)	1.01 [0.96–1.06]	0.61
Leanness sport	50.0%	31.3%	2.20 [1.38–3.50]	<0.01
Somatic assessment				
BMI (kg/m^2)	21.8 (3.5)	22 (3.4)	0.99 [0.92–1.05]	0.67
BMI <10th percentile for age and sex[a] (kg/m^2)	4.5%	0.4%	10.5 [1.21–91.0]	0.03
Fatigue score >6/10	42.6%	35.7%	1.34 [0.84–2.14]	0.23
Delayed puberty[a]	21.7%	28.6%	0.66 [0.36–1.22]	0.18
Dietary consultation				
Insufficient energy intake[a]	54.2%	35.1%	2.18 [1.33–3.57]	<0.01
Skipped meals[a]	22.4%	12.8%	1.96 [0.32–1.15]	0.02
Psychological assessment				
Body image concerns[a]	33.0%	9.7%	4.62 [2.56–8.33]	<0.01
Weight and dietary concerns[a]	41.8%	8.3%	7.95 [4.36–14.5]	<0.01
Weight variations in past year[a]	43.8%	12.7%	5.34 [3.11–9.15]	<0.01
Anxio-depressive state	47.3%	29.5%	2.15 [1.34–3.43]	<0.01
History of violence	19.6%	11%	1.98 [1.06–3.71]	0.03
Loss of self-confidence	42.9%	25.9%	2.15 [1.33–3.46]	<0.01
Doping behavior	11.6%	2.6%	4.86 [1.79–13.2]	<0.01
EDI subscale				
Drive for thinness	4.2 (4.5)	1.5 (1.7)	1.35 [1.22–1.49]	<0.01
Bulimia	1.4 (2.1)	1.0 (1.6)	1.11 [0.98–1.25]	0.10
Body dissatisfaction	6.4 (6.4)	3.4 (3.8)	1.12 [1.07–1.18]	<0.01
Ineffectiveness	3.0 (3.9)	2.5 (2.6)	1.05 [0.98–1.13]	0.15
Perfectionism	3.7 (3.8)	2.9 (2.8)	1.09 [1.01–1.17]	0.02
Interpersonal distrust	3.7 (2.9)	2.9 (2.5)	1.12 [1.03–1.21]	0.01
Interceptive awareness	3.6 (4.0)	2.6 (3.2)	1.08 [1.01–1.15]	0.02
Maturity fears	4.1 (3.5)	4.1 (3.3)	1.00 [0.94–1.07]	0.99

DE, disordered eating; %, percentage; m, mean; sd, standard deviation; OR, odds ratio; CI, confidence interval; EDI, eating disorder inventory

[a] Variables where $p < 0.25$ in univariate analysis not selected for the multivariate model (variables used by clinicians to classify into "DE detected" and "no DE detected" groups and/or variables only concerning a subgroup of athletes)

for detection. The necessity of detecting DE at an early stage is also emphasized by other authors as, on the same continuum, DE could herald the onset of clinical forms [2, 20, 35, 36]. Moreover, often, those close to athletes (family, coach, and team members) only find out about the DE when athletes' sport performances decline [23]. However, at this stage, the repercussions on self-esteem and body image and the risks of mental and physical exhaustion may lead to escalating behaviors, and the consequences of which can be dramatic.

In spite of those limitations, our findings put forward the difficulty to detect DE in athletes and the necessity to develop prevention programs for a more closely targeted public. On the one hand, athletes and healthcare professionals should be warned of the prejudice of DE and that they do not only concern female athletes. On the other hand, sports with the highest risk should be targeted and specific prevention programs for athletes competing in disciplines already identified as high risk by other authors should be setup.

Table 3 Multivariate analysis

Variables	OR [95% CI]	*p*
Doping behavior	5.66 [1.83–17.5]	<0.01
Leanness sports	2.48 [1.42–4.31]	<0.01
Fatigue score >6/10	2.12 [1.19–3.78]	0.01
Loss of self-confidence	1.85 [1.03–3.33]	0.04
EDI drive for thinness	1.30 [1.16–1.46]	<0.01
EDI body dissatisfaction	1.10 [1.02–1.18]	<0.01
EDI ineffectiveness	0.88 [0.79–0.99]	0.03

DE-associated factors in high-level athletes

$N = 331$

OR odds ratio, *CI* confidence interval, *DE* disordered eating, *EDI* eating disorder inventory

In conclusion, our study demonstrated a high prevalence of DE in high-level athletes. There were mainly EDNOS often specific to the sport community. Usual criteria do not seem to be appropriate to detect DE in athletes, making detection by clinicians all the more difficult. The clinical interview to assess athletes is, therefore, essential and we must encourage healthcare professionals to work in tandem. Priority should be given to the development of specific tools for athletes.

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Compliance with ethical standards

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Conflict of interest The authors declare no conflicts of interest associated with this research study.

Ethical approval All procedures performed in this study were in accordance with the ethical standards of the national ethics committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical measure.

Informed consent All athletes declared that they were not opposed the study. Minors were able to declare their non-opposition through a legal representative. This study was approved by the Tours Ethics Committee.

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